CLAIMS

The invention claimed is:

1. A method of depositing a layer over a substrate, comprising:

providing a substrate within a high density plasma reaction chamber;

providing at least one compound having a heavy-hydrogen isotope substituent into the reaction chamber;

generating a high density plasma within the reaction chamber; and

chemical vapor depositing a layer over the substrate, the layer incorporating at least a portion of the at least one compound.

2. The method of claim 1 wherein the heavy-hydrogen isotope is deuterium.

3. The method of claim 1 wherein the at least one compound is selected from the group consisting of SiD_xH_{4-x}, $Si_2D_yH_{6-y}$, PD_zH_{3-z}, $SiCl_2DH$, $SiCl_2D_2$, $SiO_4C_8D_qH_{20-q}$, DH, D_2, where x=1-4, y=1-6, z=1-3 and q=1-20.

4. The method of claim 1 wherein the layer comprises an oxide material.

5. The method of claim 1 wherein the layer is simultaneously deposited and etched during the depositing.

6. The method of claim 1 wherein the depositing produces a substantially planar surface.

7. The method of claim 1 wherein the at least one compound is comprised by a mixture, the mixture further comprising at least one of O_2 and O_3.

8. A method of filling a gap comprising:

providing a substrate comprising a gap structure; and

depositing a material over the substrate utilizing at least one precursor having at least one heavy-hydrogen isotope substituent; the material having less voids after the depositing than it would utilizing ^1H in place of the heavy-hydrogen.

9. The method of claim 8 wherein the gap structure comprises a trench within the substrate.

10. The method of claim 8 wherein the gap structure comprises a gap between adjacent elements.

11. The method of claim 8 wherein the gap structure is a first gap structure and wherein the substrate further comprises a second gap structure, the first gap structure being a trench and the second gap structure being a gap between elements, and wherein the depositing the material substantially fills the trench and the gap between elements.

12. The method of claim 8 wherein the at least one precursor is selected from the group consisting of SiR_xH_{4-x}, $Si_2R_yH_{6-y}$, PR_zH_{3-z}, $SiCl_2RH$, $SiCl_2R_2$, $SiO_4C_8R_qH_{20-q}$, wherein R is deuterium, tritium, or a combination thereof, and wherein x=1-4, y=1-6, z=1-3 and q=1-20.

13. A method of producing a filled area of a substrate comprising simultaneous deposition and etching of a material over the substrate in the presence of a gas comprising a heavy-hydrogen compound.

14. The method of claim 13 wherein the gas comprises a precursor component and a sputtering component, the heavy-hydrogen compound being comprised by the sputtering component.

15. The method of claim 14 wherein the heavy-hydrogen compound is a first heavy-hydrogen compound, and wherein the precursor component comprises a second heavy-hydrogen compound.

16. The method of claim 13 wherein the gas comprises a precursor component and a sputtering component, the heavy-hydrogen compound being comprised by the precursor component.

17. The method of claim 13 wherein the gas comprises at least one of D_2, HD, DT, T_2 and TH.

18. The method of claim 17 wherein the gas further comprises H_2.

19. The method of claim 13 where the filled area comprises at least one feature selected from the group consisting of a trench and a space between elements.

20. The method of claim 19 wherein one or more of the at least one feature has an aspect ratio of greater than about 1:1.

21. The method of claim 19 wherein one or more of the at least one feature has an aspect ratio of greater than about 2:1

22. The method of claim 19 wherein one or more of the at least one feature has an aspect ratio of greater than about 3:1

23. The method of claim 19 wherein one or more of the at least one feature has an aspect ratio of greater than about 4:1.

24. The method of claim 19 wherein one or more of the at least one feature has an aspect ratio of greater than about 5:1.

25. The method of claim 19 wherein one or more of the at least one feature has a width of less than about 10 nm.

26. The method of claim 13 wherein deposition occurs over a rugged topography, and produces a more even surface relative to the rugged topography.

27. The method of claim 13 wherein the material is selected from the group consisting of boron/phosphorous doped silicon oxide, fluorine doped silicon oxide, phosphorous doped silicon oxide, boron doped silicon oxide, and undoped silicon oxide.

28. A method of controlling an overall deposition rate during high density plasma chemical vapor deposition comprising providing at least one compound comprising a heavy-hydrogen isotope during the deposition, the overall deposition rate being defined by a ratio of deposition rate of a material relative to a simultaneous rate of etch of the material.

29. The method of claim 28 wherein the at least one compound is provided in a sputtering gas.

30. The method of claim 29 wherein the at least one compound is selected from the group consisting of diatomic hydrogen having at least one atom selected from D and T.

31. The method of claim 29 wherein the deposition occurs across a surface of a wafer and wherein the overall deposition rate at a central point of the surface of the wafer is substantially equivalent to an overall deposition rate at a point at an edge of the surface of the wafer.

32. The method of claim 31 wherein the overall deposition rate at the central point is substantially equivalent to an overall deposition rate that occurs at substantially all points along a line between the center point and the point at the edge of the surface of the wafer.

33. The method of claim 29 wherein the deposition occurs across a surface of a wafer and wherein the overall deposition rate at any point across the surface of the wafer is substantially equivalent to an overall deposition rate at every other point across the surface of the wafer.

34. The method of claim 17 wherein the deposition comprises deposition of an insulative material over a substrate having one or more gaps, the deposition filling the one or more gaps with the insulative material to form filled gaps having a substantial absence of voids.

35. The method of claim 17 wherein the overall rate of deposition is decreased relative to a corresponding overall deposition rate that occurs utilizing the ^{1}H form of the at least one compound under otherwise identical deposition conditions.

36. A method of filling high aspect ratio gaps in a semiconductor substrate, comprising:

providing the substrate within a reaction chamber;

providing a gas mixture comprising at least one heavy-hydrogen containing compound within the reaction chamber; and

reacting the gas mixture to form a layer of material over the substrate by simultaneous deposition and etch of the layer, the layer of material filling the high aspect ratio gaps, the material within the gaps being essentially void-free.

37. The method of claim 36 wherein the reaction chamber is a high density plasma chemical vapor deposition chamber.

38. The method of claim 36 wherein the at least one heavy-hydrogen containing compound is selected from the group consisting of SiR_xH_{4-x}, $Si_2R_yH_{6-y}$, PR_zH_{3-z}, $SiCl_2RH$, $SiCl_2R_2$, $SiO_4C_8R_qH_{20-q}$, HR, and R_2, wherein R is deuterium, tritium, or a combination thereof, and wherein x=1-4, y=1-6, z=1-3 and q=1-20.

39. A method of providing an improved deposition rate uniformity comprising depositing a material over a surface in the presence of at least one gas selected from the group consisting of D_2, HD, DT, T_2 and TH, the depositing occurring at an overall deposition rate defined by a ratio of deposition of the material relative to a simultaneous rate of etch of the material, the overall deposition rate having a degree of variance across the surface which is measurably improved relative to a corresponding degree of variance that occurs during deposition utilizing H_2 under otherwise substantially identical conditions.

40. The method of claim 39 wherein the depositing comprises high-density plasma deposition.

41. The method of claim 39 wherein the degree of variance utilizing the at least one gas is improved at least about 18% relative to the corresponding degree of variance that results utilizing mass one H_2.

42. The method of claim 39 wherein the depositing comprises high-density plasma deposition onto a substrate utilizing a high frequency bias power of less than about 5 kW.

43. The method of claim 39 wherein the surface is comprised by a 200 mm diameter wafer.

44. The method of claim 39 wherein the surface comprised by a 300 mm diameter wafer.